

Engineering Visualization

Visualizing Real Time Physics

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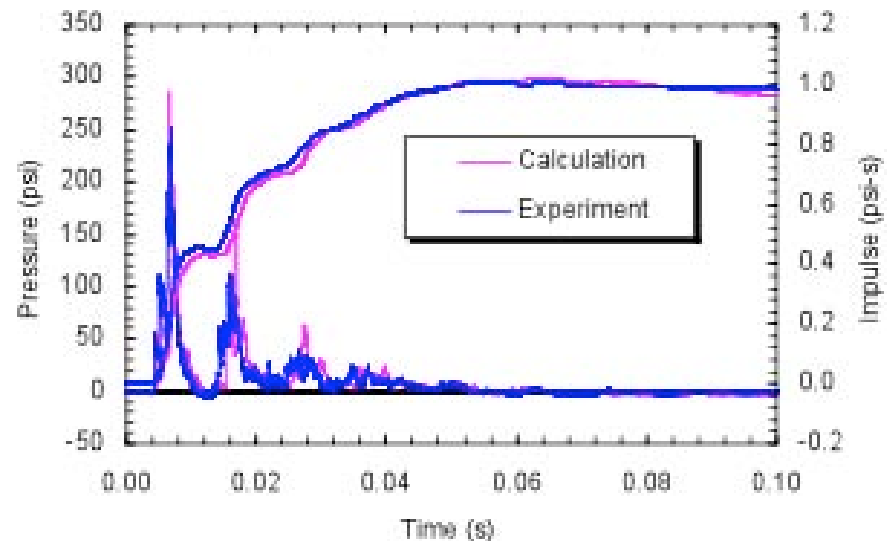
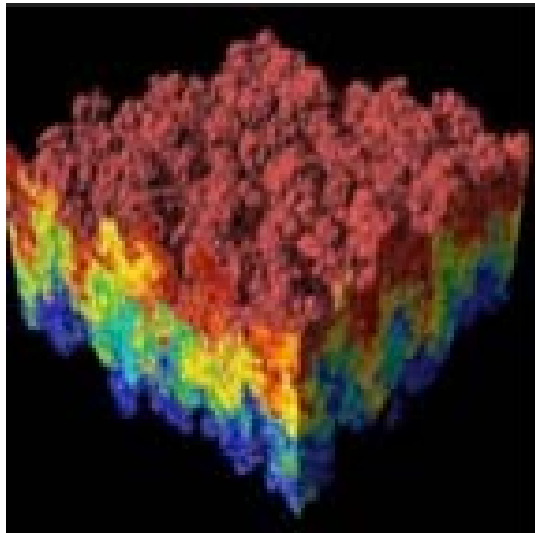
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Overview

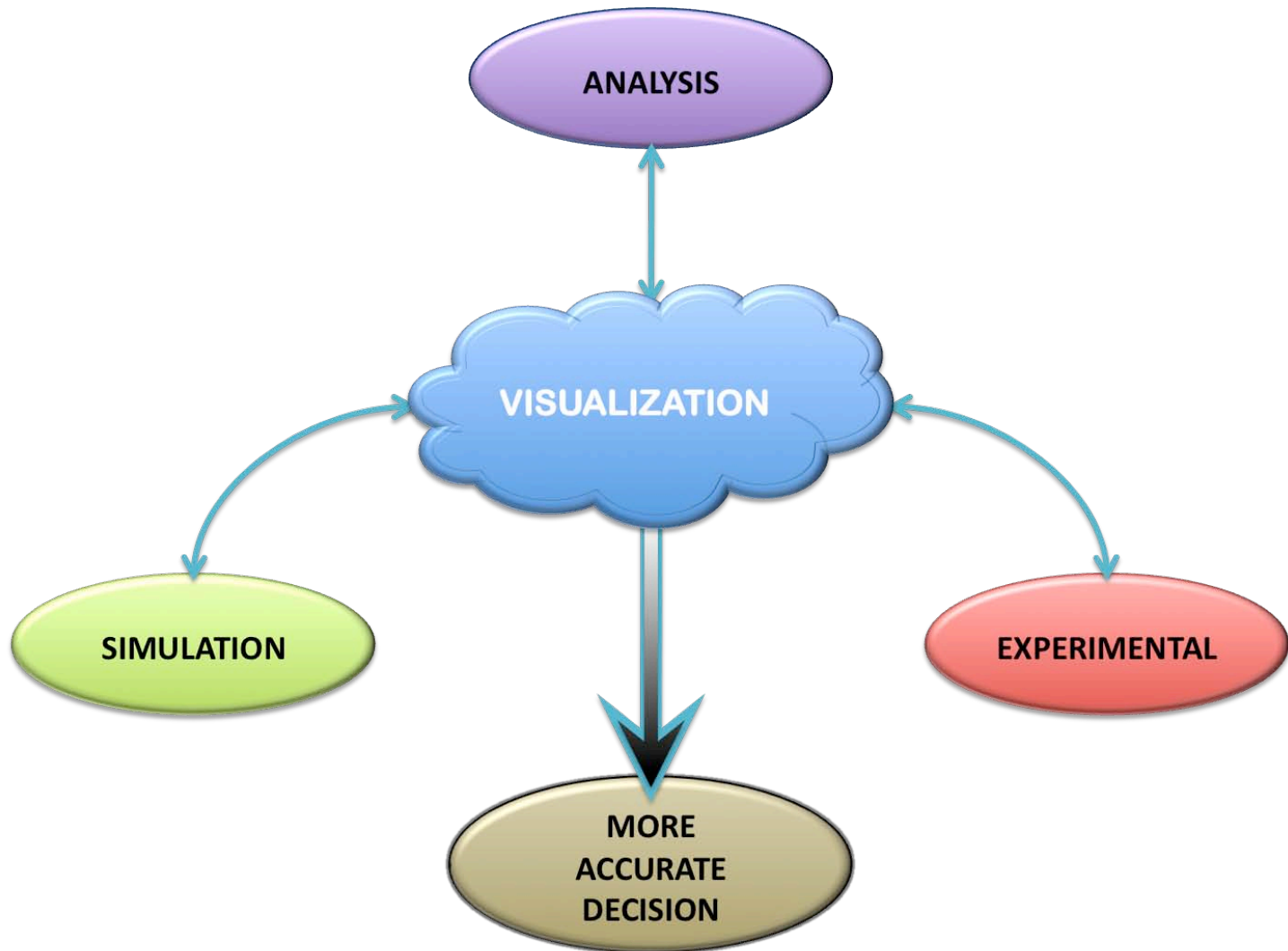
- What/Why engineering visualization (Vis)
- How is it used
- How can we use it – new capabilities
- Completed Projects
- Future opportunities
- Summary

What is Engineering Visualization

- 3D computer visualization for analyzing massive data and presenting it so humans can easily comprehend



What is Engineering Visualization



Who Uses Engineering Visualization

- Northrop Grumman sold UCAS program (aircraft carrier operations) to Navy with simulation and engineering Vis
- Northrop Grumman engineers catch design flaws and correct them along the way.



What is Virtual Reality

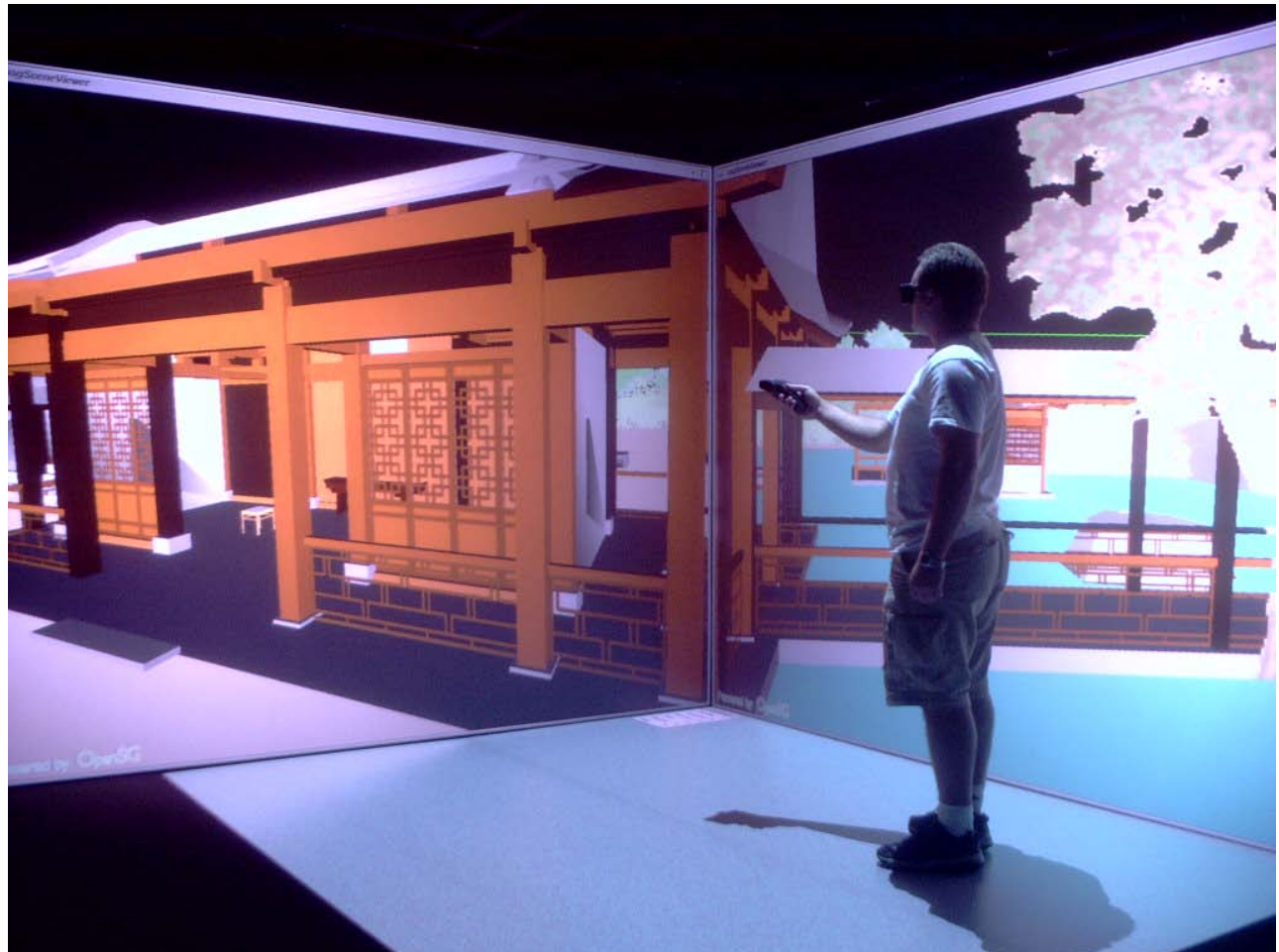
- VR uses visualization
 - adds interaction and exploration
 - adds 3D/stereo
 - adds immersion
 - adds “life size” capabilities

Who Uses Virtual Reality



- Navy's newest aircraft carrier designed with VR by Northrop Grumman.
- Saved millions of dollars in design costs.
- Raytheon building a CAVE

What is a “CAVE”?



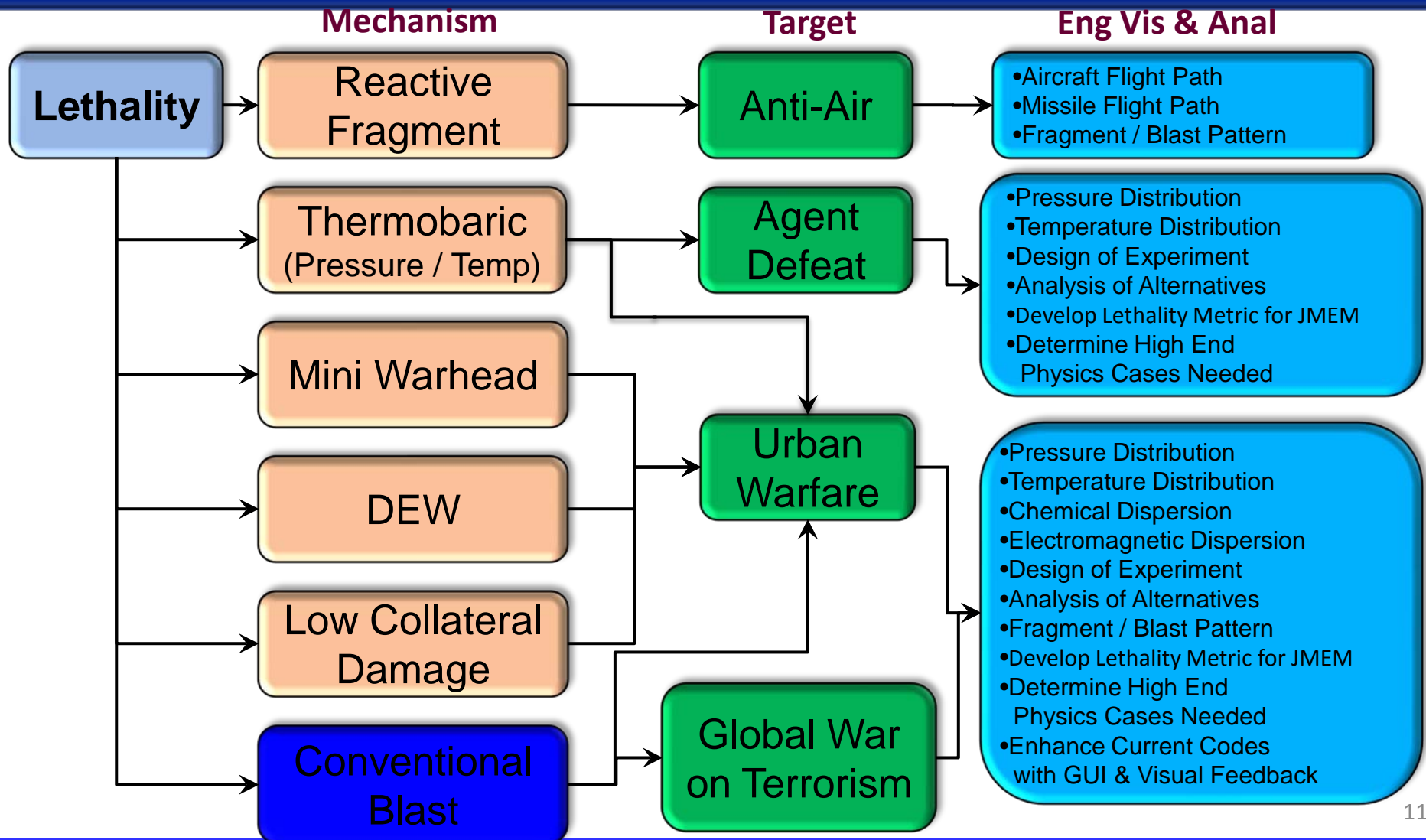
Why Engineering Vis for Warfare Analysis

- Current analysis tools not developed for new warheads and missions
- Visualization can meet emerging warfare analysis/mission needs AND strengthen existing capabilities
- Government can meet needs of 21st century warfighter if we become world experts in engineering visualization for warfare analysis

Focus Areas for Warfare Analysis

- Enhance current legacy codes
 - GUI Development
 - Post Processing Capability
 - Data Mining Capabilities
- Develop new tools and methodologies
 - Quick Look Tools
 - Visualization of Experimental, Simulation, and Quick Look for Smarter Data Evaluation

Lethality Workflow Example



Possible Enhancements

- **Redefine Workflow**
 - Models with advanced metadata
 - Utilization of real time techniques
- **Development & Enhancement Costing**
 - Validation of techniques
 - Internal development money
 - Shared costing amongst all programs
 - Partially funding workflow development and validation

Real Time Physics

- Applications
 - Interactive systems
 - Virtual Simulators
 - Serious Games – Military Training
- Requirements
 - Fast 30-60 fps
 - Stable in any possible, non-predictable situation
- Challenge
 - Approach offline results while meeting all requirements



Real Time Physics

- New codes have powerful multi-physics solvers
 - fluid-particle & dynamic surface technology avoid time consuming meshing
 - allows a fast virtual prototype based on real-world physics

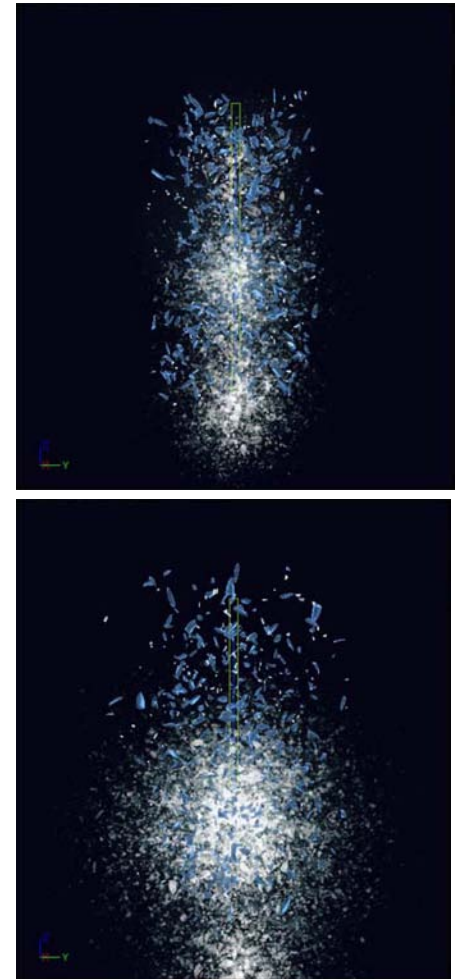
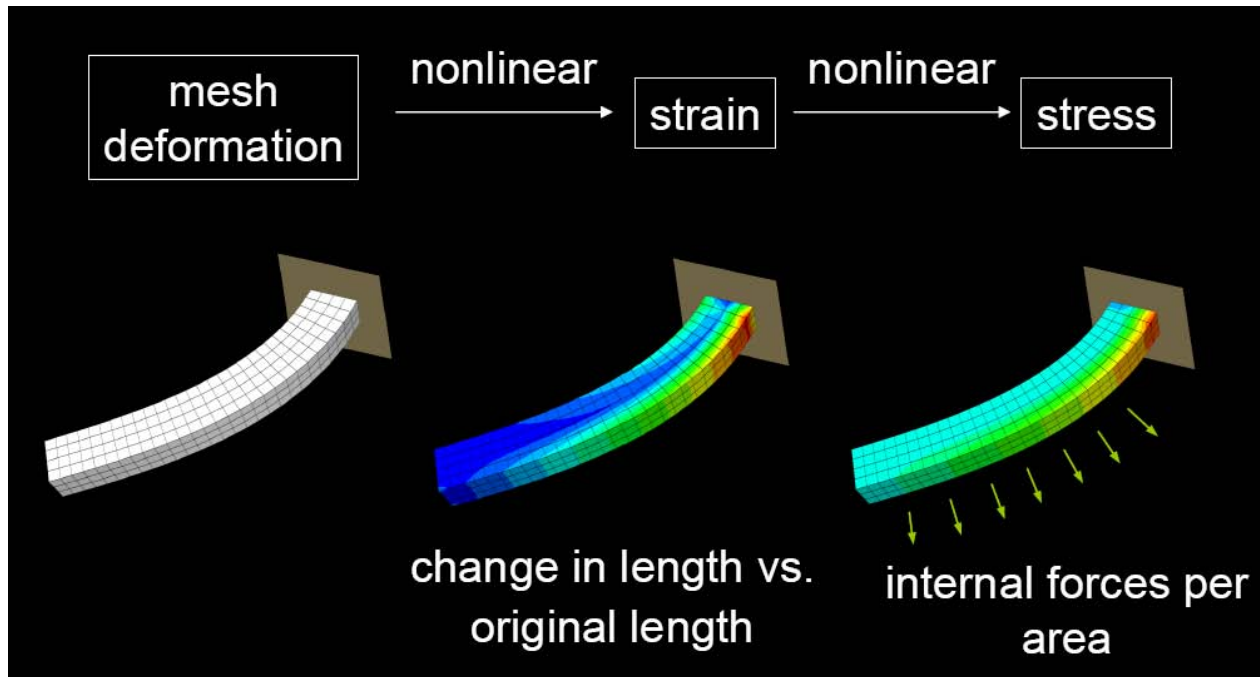


Real Time Physics

- Enables the ability to study the mechanics of fluids and solids in a coupled efficient and timely manner
 - Specifically in the design and experimental setup stage where preliminary analysis may save costs & time
 - Based on the materials used a complete 3D virtual space is created for visualizing from any angle and at any time slice



Real Time Fracture Example



New Software Tools

- Houdini
 - originally designed for other purposes
 - but includes features for engineering visualization
 - provides faithful representation of fluid solution/dynamics
 - excellent for rapid prototyping of setups for high-end physics simulations

Engineering Visualization

Blast / Detonation

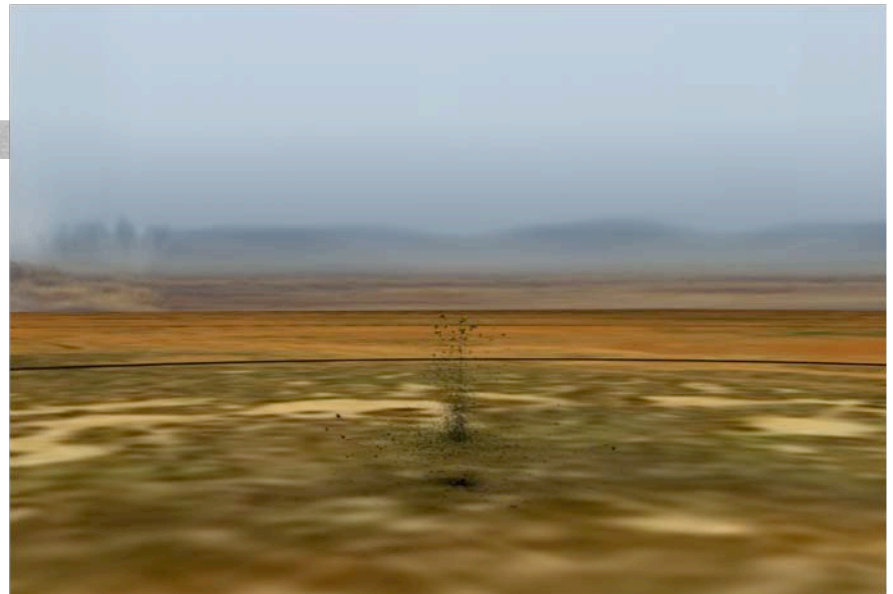
- An important aspect of modeling a PES is how the structure behaves under explosive loading:
 - How much debris is produced and where is it thrown?
 - What is the mass distribution of the debris?
 - How far does the debris get thrown?
 - What is the azimuthally distribution of the debris?
 - How much external airblast attenuation is provided by the structure?

Fragment Example With Houdini



Direct Visual of 25,000 Fragment Positions

Direct Visual of 25,000 Fragment



High Quality Terrain Visualization



Engineering Visualization

Urban Buildings / City



JMEWS Visualization

- Visualization of JMEWS warhead
 - develop new material models
 - Illustrate workings for SNORT test
 - Accomplish 50% solution
- This solution changed an entire portion of a test through demonstration of complete system – first look
- Completed and Demonstrated to sponsor
- Follow on work in the planning stage

Summary

- New tools available for use
- Enhance Understanding
- Reduce Testing

